Association between serum 25-hydroxy vitamin D and inflammatory markers

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Background: Serum 25-hydroxy vitamin D (25[OH]D) is an accurate measure of vitamin D status. Aside from the known relationship between vitamin D and bone, vitamin D has also been implicated in immune function and inflammation. Lower circulating serum (25[OH]D) has been associated with higher circulating concentrations of the inflammatory markers in individuals with congestive heart failure, rheumatoid arthritis and severely obese subjects. However, this relationship is not well studied in healthy individuals, especially in men. Moreover, several studies using data have reported that higher levels of physical activity are associated with lower level of inflammatory markers. On the other hand, it has been reported that higher physical activity level is positively related with serum 25(OH)D concentrations. Therefore, physical activity may modify the association between serum 25(OH)D and inflammatory markers. But the relationship has not been examined yet.

Purpose: The purpose of this study was to examine the associations among serum 25(OH)D and inflammatory markers, with consideration for physical activity.

Methods: A total of 94 Japanese (age 44±14yrs, body mass index 22.2±3.0kg/m^2) participated in our study. Fasting blood samples were collected in the morning and analyzed for 25(OH)D, interleukin-17(IL-17),interleukin-6 (IL-6) and interferon-gamma (IFN-γ) using an enzyme-linked immunosorbent assay. Daily physical activity was assessed using accelerometer-based activity monitors (Lifecorder). Total percent body fat (%fat) was determined by dual energy X-ray absorptiometry (DXA). Serum vitamin D status was classified by concentration of serum 25(OH)D as deficiency (<20ng/ml), insufficiency (20-30ng/ml), and sufficiency (>30 ng/ml).

Results: Of the 94 Japanese, 73 (78%) were deficient, 18 (19%) were insufficient, and only 3 (3%) were sufficient for the serum 25(OH)D status. No significant association was found between serum 25(OH)D and plasma IFN-γ or IL-6. Serum 25(OH)D was positively and significantly related to the level of plasma IL-17 in men, but not in women. The relationship was remained even after being adjusted for age and % fat, but the relationship disappeared when

additionally adjusted for vigorous physical activity (VPA).

Conclusion: This study revealed a high prevalence of serum 25(OH)D insufficiency and deficiency, and that elevated serum 25(OH)D concentrations were associated with increased plasma IL-17 concentrations in healthy Japanese men. In addition, the relationship was found to be influenced by the level of VPA.

Table 1 Subject characteristics divided by gender

Variable	Total	Men	Women	P Value*
Age (yr)	44 ± 14	43 ± 16	44 ± 13	0.563
Height (cm)	160.8 ± 17.0	170.1 ± 5.7	155.8 ± 18.9	<0.001
Weight (kg)	58.6 ± 10.4	69.1 ± 6.5	53.0 ± 7.3	<0.001
BMI (kg/m^2)	22.2 ± 3.0	24.0 ± 2.6	21.2 ± 2.8	<0.001
Body fat (%)	23.5 ± 6.3	18.1 ± 4.8	26.5 ± 5.0	<0.001
25(OH)D (ng/ml)	13.9 ± 8.1	16.5 ± 9.7	12.5 ± 6.9	0.041
IL-6 (pg/ml)	0.47 ± 0.53	0.43 ± 0.43	0.49 ± 0.58	0.900
IFN-γ (pg/ml)	1.02 ± 0.89	1.14 ± 0.90	0.95 ± 0.89	0.300
IL-17 (pg/ml)	23.0 ± 29.24	21.17 ± 19.39	23.98 ± 33.26	0.808
PTH (pg/ml)	63.2 ± 21.7	58.1 ± 21.6	66.0 ± 21.5	0.052
MVPA (min/d)	33.6 ± 21.2	34.3 ± 23.9	33.1 ± 19.8	0.913
VPA (min/d)	4.0 ± 5.2	4.8 ± 6.9	3.5 ± 4.0	0.784

Data are means±SD. PTH, parathyroid hormone; MVPA, moderate to vigorous physical activity; VPA, vigorous physical activity; 25(OH)D, 25-hydroxy vitamin D; IFN, interferon; IL, interleukin. *For gender difference.

Table 2. Results from multiple linear regression analysis examining the association of serum 25(OH)D with plasmaIL-17 in men.

	β	P	R^2
Model 1			
Serum 25(OH)D(ng/ml)	0.451	**0.018**	0.277
Model 2			
Serum 25(OH)D(ng/ml)	0.392	**0.04**	0.249
Model 3			
Serum 25(OH)D(ng/ml)	0.303	0.145	0.274

Model 1was adjusted for age and percentage body fat; Model 2 included model 1 plus moderate to vigorous physical activity (MVPA); Model 3 included model 1 plus vigorous physical activity (VPA). MVPA, VPA and plasma IL-17 was log-transformed before performing the analysis.